Tutorial
H-1000-5320-01-B

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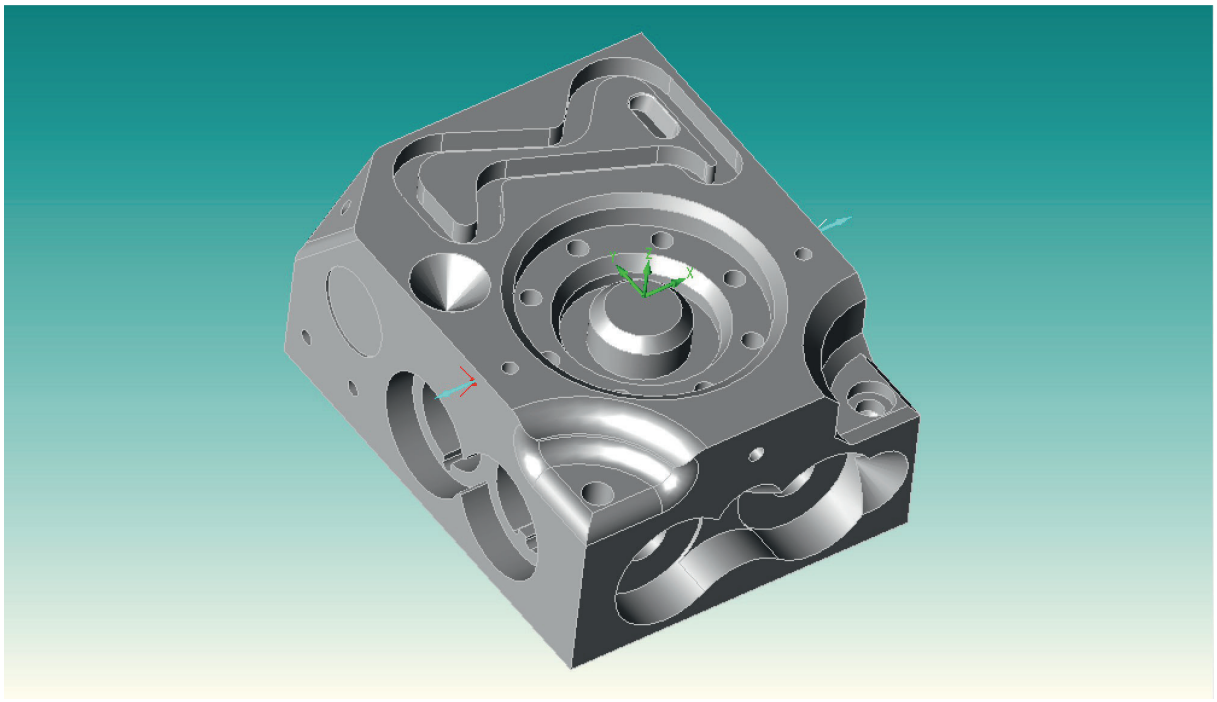
Further feature measurement and output (CAD)



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Further feature measurement and output (CAD)

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Contents

1 Further feature measurement and output (CAD)

1.1 Tutorial pre-requisites

- The student should have completed, and have a sound knowledge of all ‘Alignment’ tutorials and ‘Further CNC measurement function’ tutorials

1.2 Tutorial objectives

- Further exposure to feature measurement using data obtained from a CAD model
- Introduction to the tolerancing and output of measured results
- Introduction to the creation of simple reports
- Introduction to the use of polar co-ordinates for both measurement and output

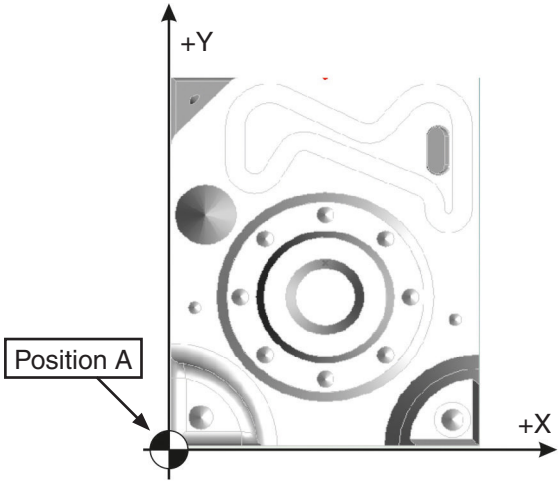
2 Introduction

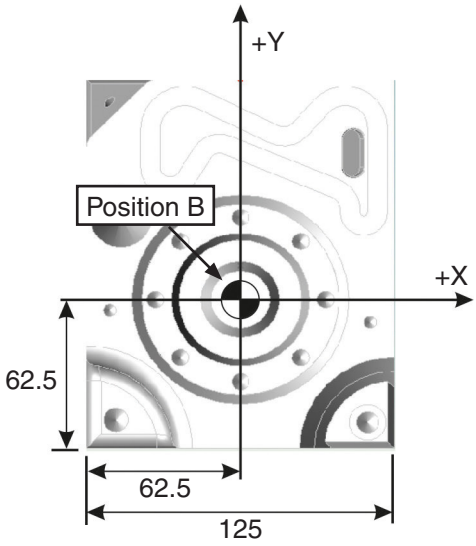
This tutorial will further develop feature measurement skills as well introducing the student to the tolerancing and output of measured results. Additionally, the student will be introduced to the concept of defining feature position by using radial and angular parameters which are particularly useful when features have rotational symmetry about a datum.

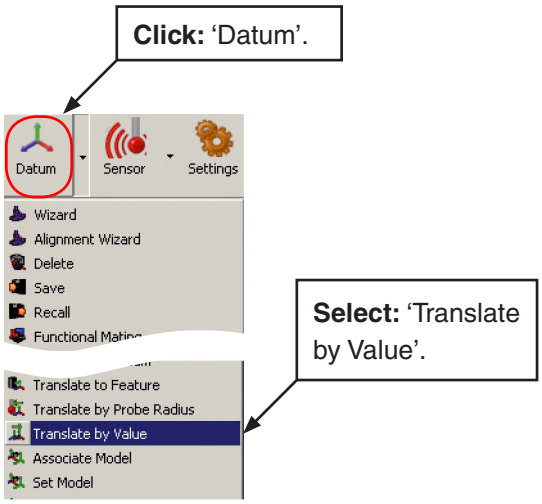
3 Apply tolerance functions to measured features

Use the ‘Plane, line and point’ program to generate the alignment. Ensure that the program is in CNC mode following this alignment. To do this go to ‘Settings’ select ‘Mode’ then select ‘Program (CNC)’.

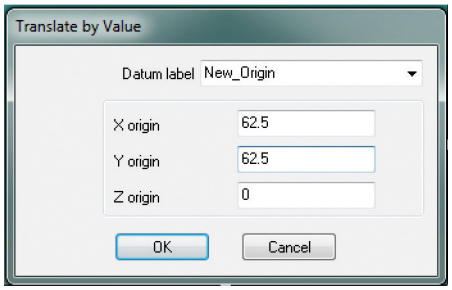
Move / translate origins from position A to position B:







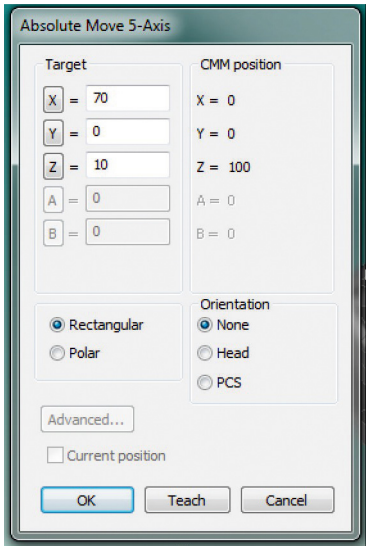
Enter the drawing values:



Now measure some points, add tolerances to them and then output the measured results.

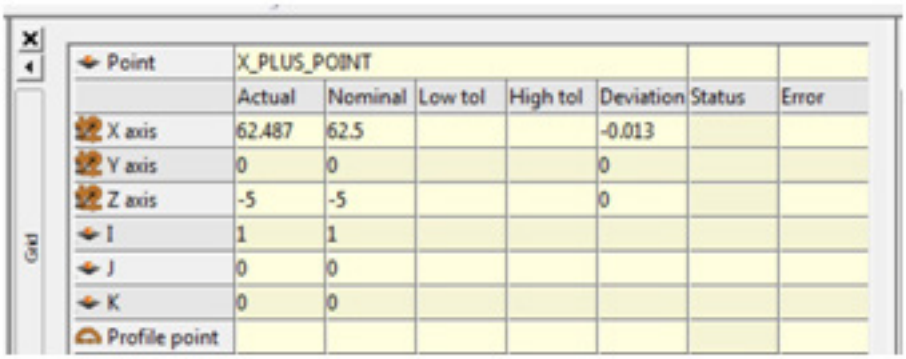
NOTE: The program will NOT show any new code at this point.

Move the probe to the right hand face of block using an ‘Absolute’ GOTO move:



Click on the CAD at the point to be measured and to obtain the point nominal data.

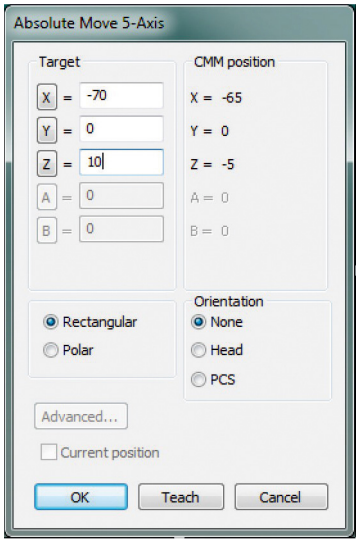
If necessary modify the nominal data to ensure the point is taken at the desired position.



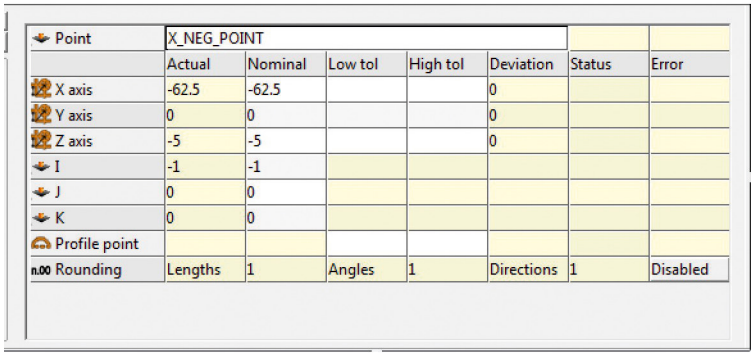
Point	X_PLUS_POINT						
	Actual	Nominal	Low tol	High tol	Deviation	Status	Error
X axis	62.487	62.5			-0.013		
Y axis	0	0			0		
Z axis	-5	-5			0		
I	1	1					
J	0	0					
K	0	0					
Profile point							

Click: ‘Apply’ to complete the measurement process.

Now move the probe to the left hand face of the block using an ‘Absolute’ GOTO move:



Again, click on the CAD at the point to be measured and to obtain the point nominal data. If necessary modify the nominal data to ensure the point is taken at the desired position.

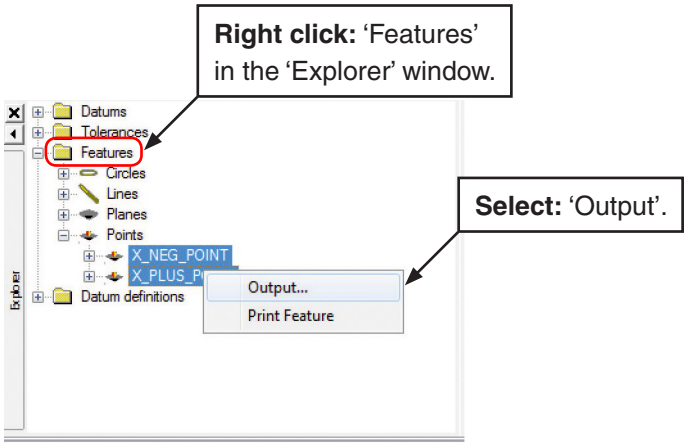


Point	X_NEG_POINT						
	Actual	Nominal	Low tol	High tol	Deviation	Status	Error
X axis	-62.5	-62.5			0		
Y axis	0	0			0		
Z axis	-5	-5			0		
I	-1	-1					
J	0	0					
K	0	0					
Profile point							
Rounding	Lengths	1	Angles	1	Directions	1	Disabled

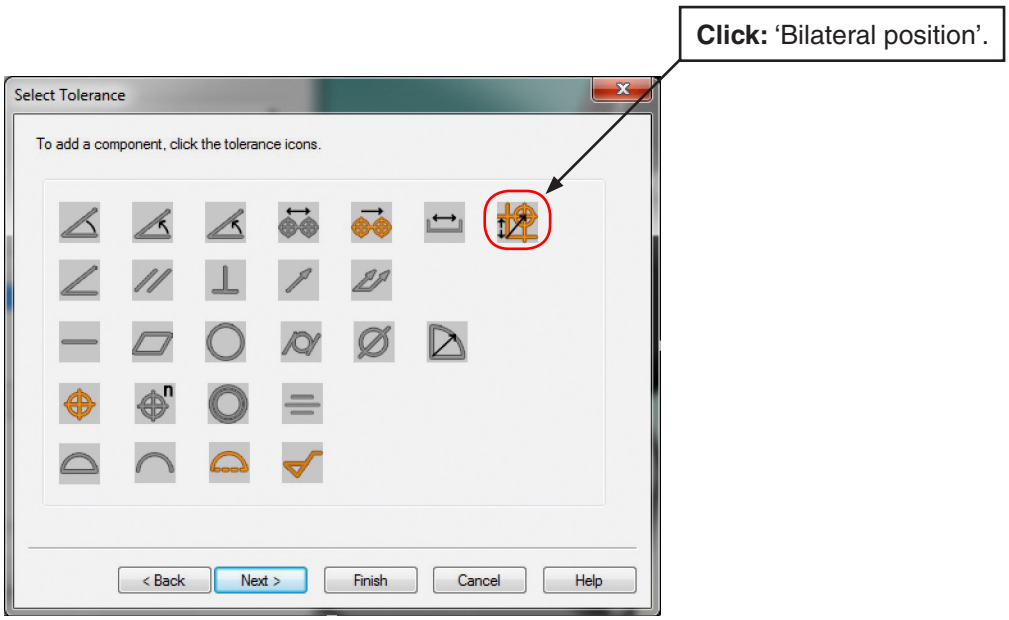
Click: ‘Apply’ to complete the measurement process.

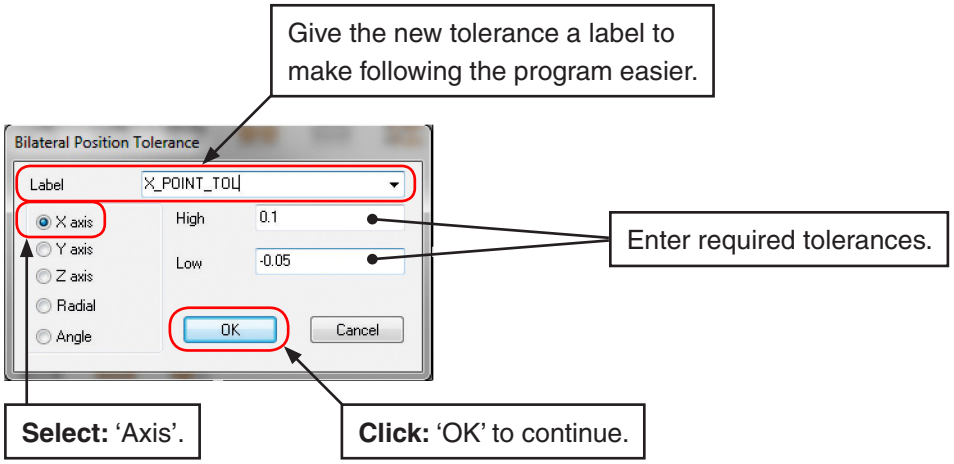
4 Output of measured results

In the ‘Explorer’ window under ‘Features’, right mouse click on the points measured and select ‘Output’. Next select ‘New’.

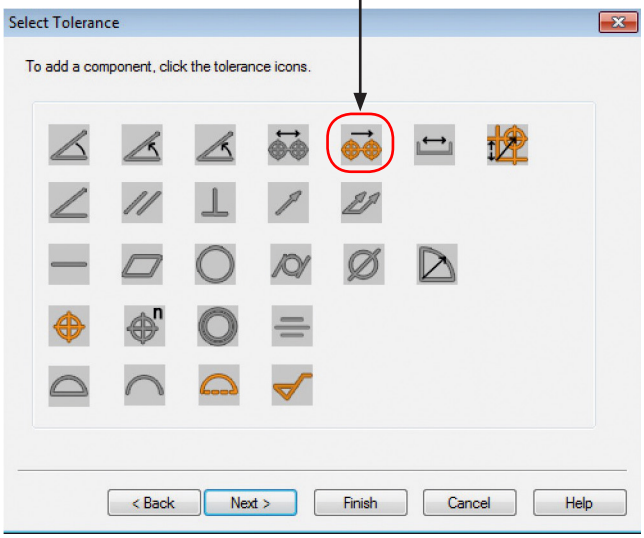


After selecting the measured feature(s) to output click ‘New’.

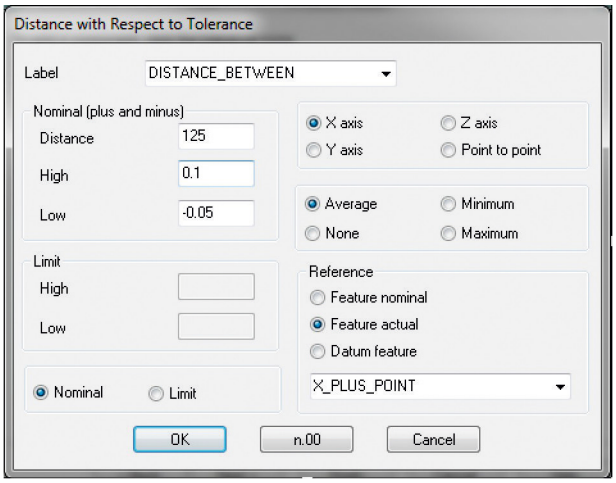




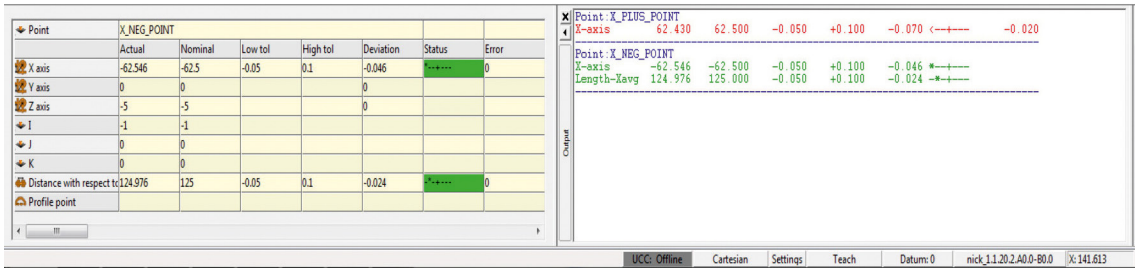
Click: ‘New then select ‘Distance With Respect To’ tolerance’.



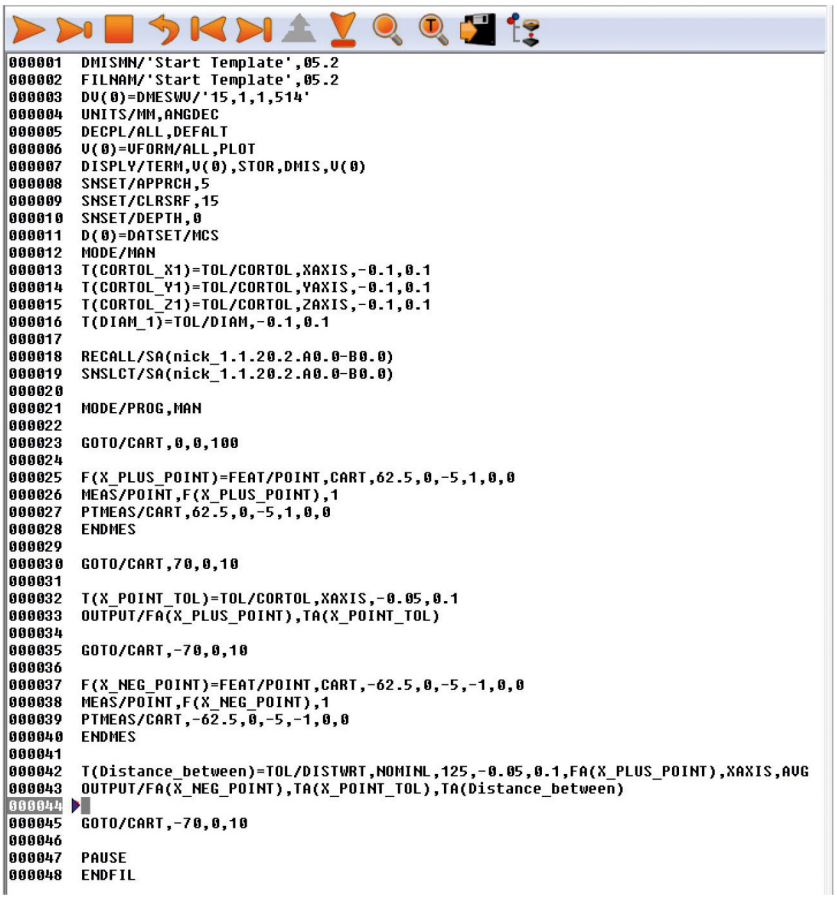
Input all details as required including axis then click ‘OK’ to continue. For further info: Press F1.



Tolerances applied in grid and output window:



DMIS code generated for program working in Cartesian:



```
000001  DMISMN/'Start Template',05.2
000002  FILNAM/'Start Template',05.2
000003  DV(0)=DMESWV/'15,1,1,514'
000004  UNITS/MM,ANGDEC
000005  DECPL/ALL,DEFALT
000006  V(0)=VFORM/ALL,PLOT
000007  DISPLY/TERM,V(0),STOR,DMIS,V(0)
000008  SNSET/APPRCH,5
000009  SNSET/CLRSRF,15
000010  SNSET/DEPTH,0
000011  D(0)=DATSET/MCS
000012  MODE/MAN
000013  T(CORTOL_X1)=TOL/CORTOL,XAXIS,-0.1,0.1
000014  T(CORTOL_Y1)=TOL/CORTOL,YAXIS,-0.1,0.1
000015  T(CORTOL_Z1)=TOL/CORTOL,ZAXIS,-0.1,0.1
000016  T(DIAM_1)=TOL/DIAM,-0.1,0.1
000017
000018  RECALL/SA(nick_1.1.20.2.A0.0-B0.0)
000019  SNSLCT/SA(nick_1.1.20.2.A0.0-B0.0)
000020
000021  MODE/PROG,MAN
000022
000023  GOTO/CART,0,0,100
000024
000025  F(X_PLUS_POINT)=FEAT/POINT,CART,62.5,0,-5,1,0,0
000026  MEAS/POINT,F(X_PLUS_POINT),1
000027  PTMEAS/CART,62.5,0,-5,1,0,0
000028  ENDMES
000029
000030  GOTO/CART,70,0,10
000031
000032  T(X_POINT_TOL)=TOL/CORTOL,XAXIS,-0.05,0.1
000033  OUTPUT/FA(X_PLUS_POINT),TA(X_POINT_TOL)
000034
000035  GOTO/CART,-70,0,10
000036
000037  F(X_NEG_POINT)=FEAT/POINT,CART,-62.5,0,-5,-1,0,0
000038  MEAS/POINT,F(X_NEG_POINT),1
000039  PTMEAS/CART,-62.5,0,-5,-1,0,0
000040  ENDMES
000041
000042  T(Distance_between)=TOL/DISTWRT,NOMINL,125,-0.05,0.1,FA(X_PLUS_POINT),XAXIS,AVG
000043  OUTPUT/FA(X_NEG_POINT),TA(X_POINT_TOL),TA(Distance_between)
000044
000045  GOTO/CART,-70,0,10
000046
000047  PAUSE
000048  ENDFIL
```

5 Generation of report from feature grid

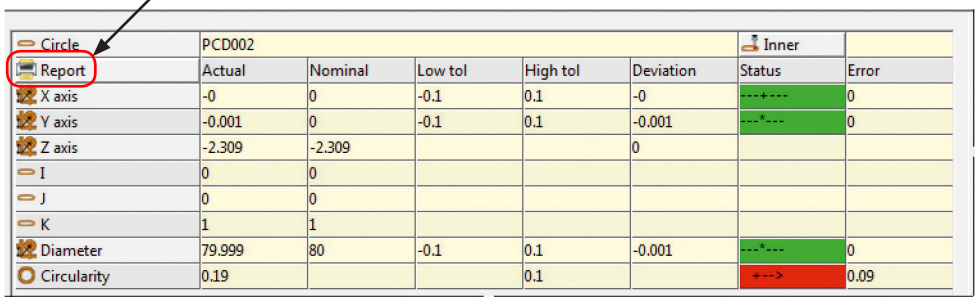
Prerequisite: A measured feature must be present in the program which has had tolerances applied.

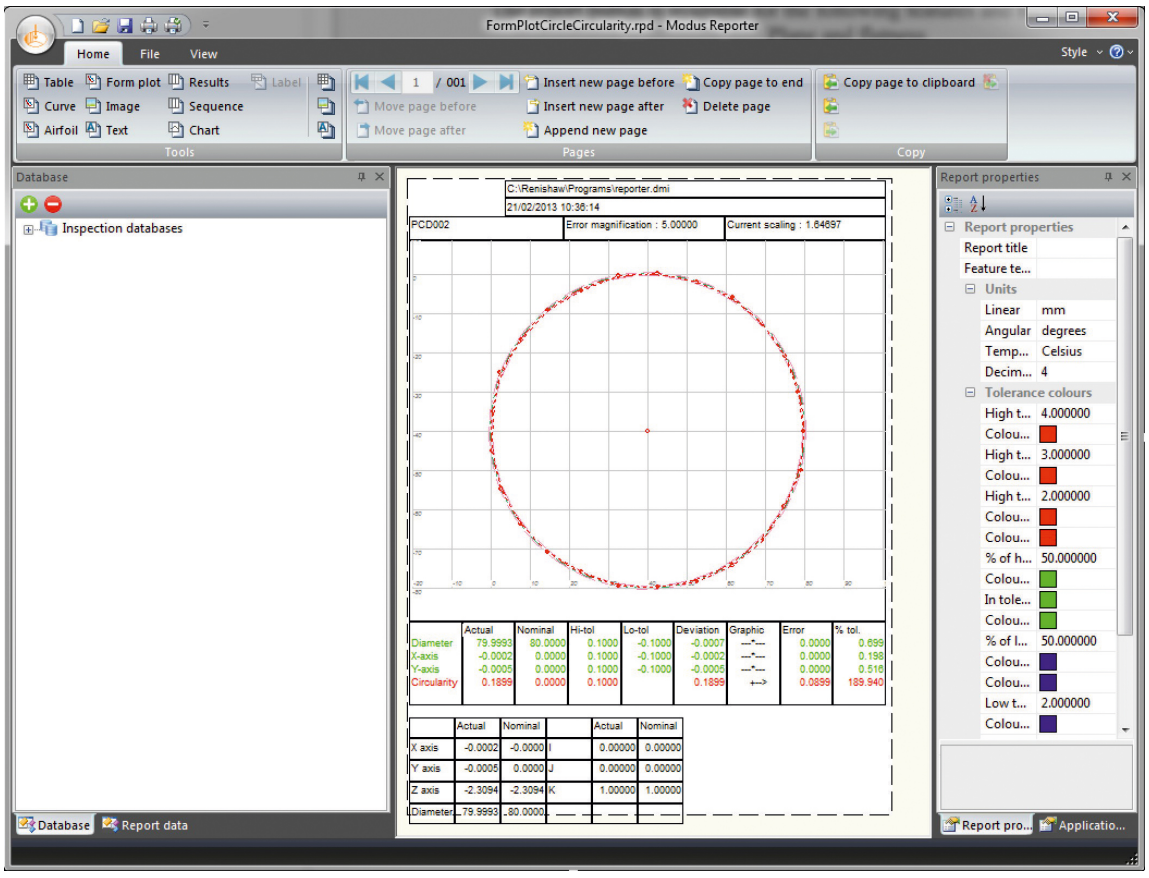
When the report button is available, start ‘MODUS reporter’ directly from the grid window and display a form plot report appropriate for the feature selected in the grid window.

The report button is available for the following features and form tolerance types:

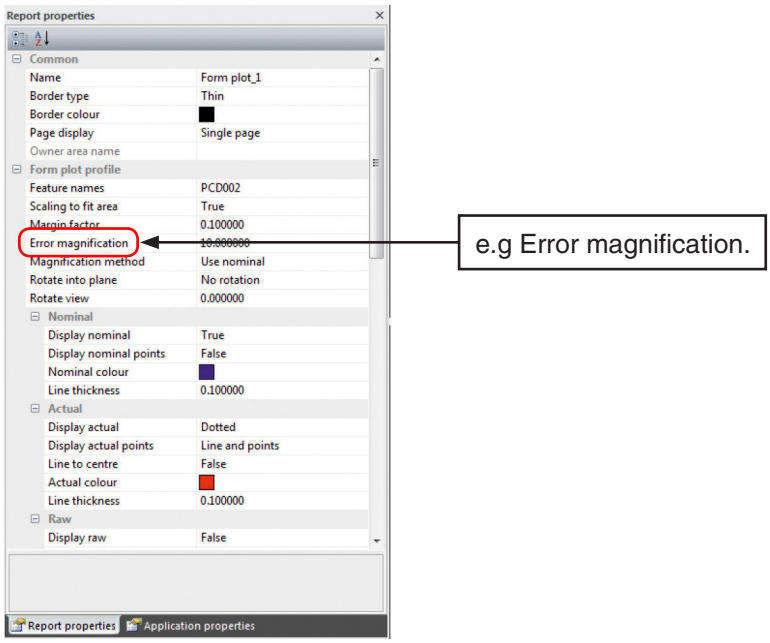
- Plane and flatness
- Line and straightness
- Circle and circularity
- Circle and circular runout
- Surface finish
- Airfoil

Click: ‘Report’ button to open ‘MODUS reporter’ as displayed below.





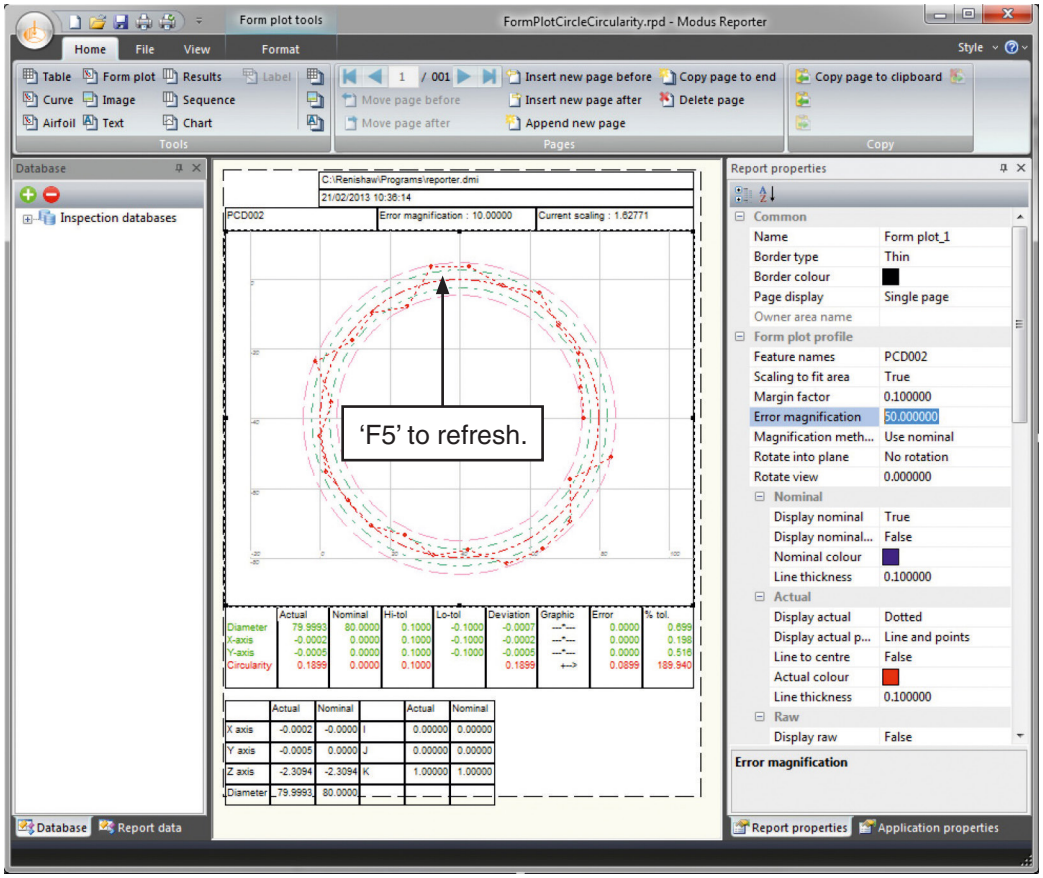
Use the report properties window to view and edit the properties of the selected area of the report.



Select the ‘Form Plot’ by clicking on it in the report page.

Error magnification has been used as an example. Adjust as required. After properties have been amended press ‘F5' to view all amendments made.

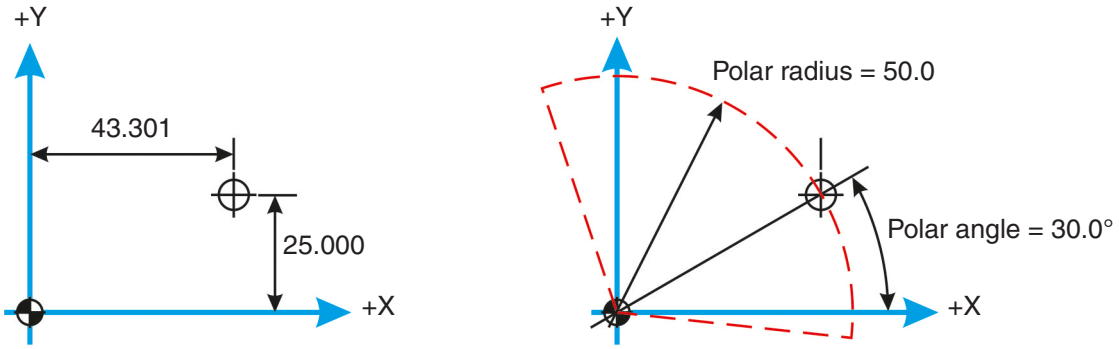
For further details on report properties refer to the ‘Reporter’ help (F1) or subsequent tutorial.



To print report, click print icon and follow on screen instructions

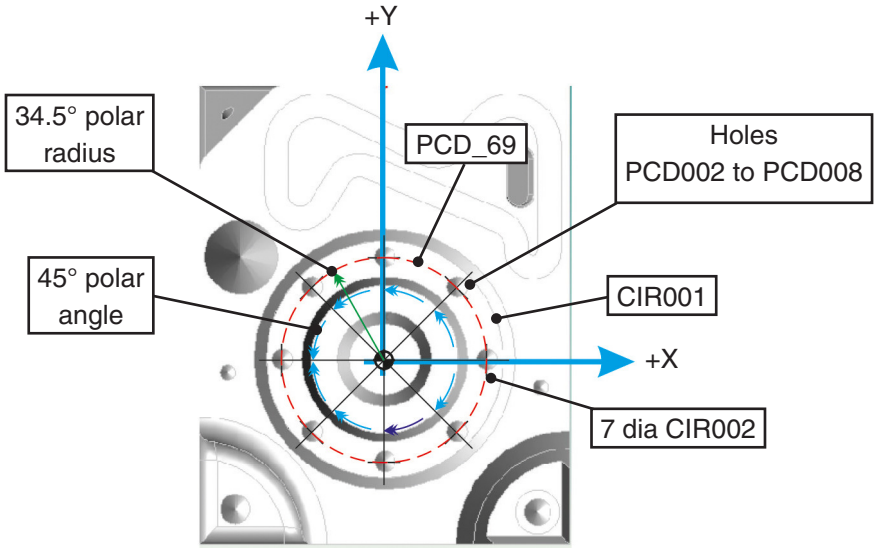
6 Working in polar co-ordinates

In some cases when a part is measured, the output dimensions are required in the polar format. This enables angular and radial positions of a feature with respect to the current datum system instead of the default Cartesian (X and Y etc.).



Remember: Angles are struck from the major axis of the working plane.

In this part of the tutorial the eight holes shown below will be measured, and then output their position as a polar radius and polar angle.



Prior to measuring the holes carry out a precise alignment of the component as described in previous tutorials.

Switch MODUS into polar mode using the lower task bar. The default condition is Cartesian.

NOTE: The program will NOT show any new code at this point.

Move the probe to a position over circle PCD002 and make an 'Absolute' GOTO:

000033 ▶ GOTO/POL,34.5,45,5

The GOTO statements are now in polar.

The format is 'Radius', 'Angle', 'Height'. Angles will be expressed between 0 to 180 / 0 to -180.

Measure the final seven holes as normal giving each of them a label (PCD002 to PCD008).

Insert GOTO moves to clear the part.

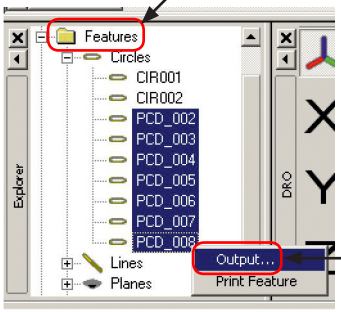
The program code should look something like this:-

```
GOTO/POL,34.5,-45,5

$$<MEAS_CIRCLE name = "PCD008">
F(PCD008)=FEAT/CIRCLE,INNER,POL,34.5,-45,-10,0,0,1,7
MEAS/CIRCLE,F(PCD008),4
PTMEAS/POL,34.449,-50.819,-12.092,0.752,0.659,0
PTMEAS/POL,36.364,-49.793,-11.308,0.263,0.965,0
PTMEAS/POL,37.909,-46.258,-11.444,-0.519,0.855,0
PTMEAS/POL,37.981,-44.427,-13.791,-0.78,0.626,0
ENDMES
$$<\MEAS_CIRCLE = PCD008>

GOTO/POL,34.5,-45,5
```

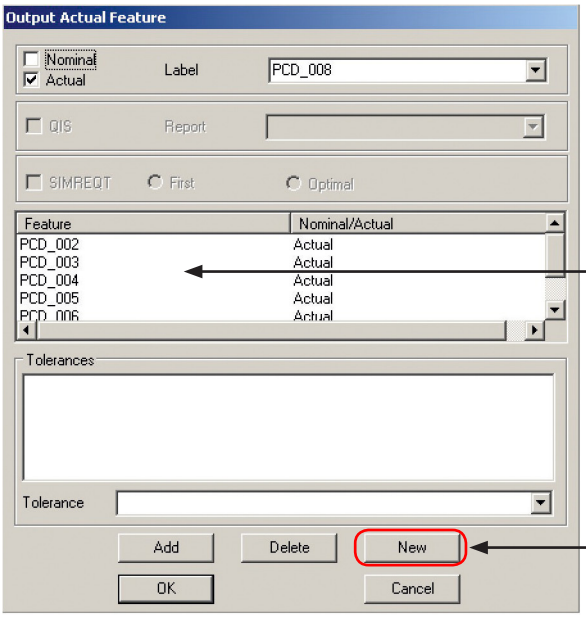
After the program has finished the following information should be seen:

7 Output of measured results in polar co-ordinates

Using the ‘Explorer’ window highlight the ‘Features’ to output.



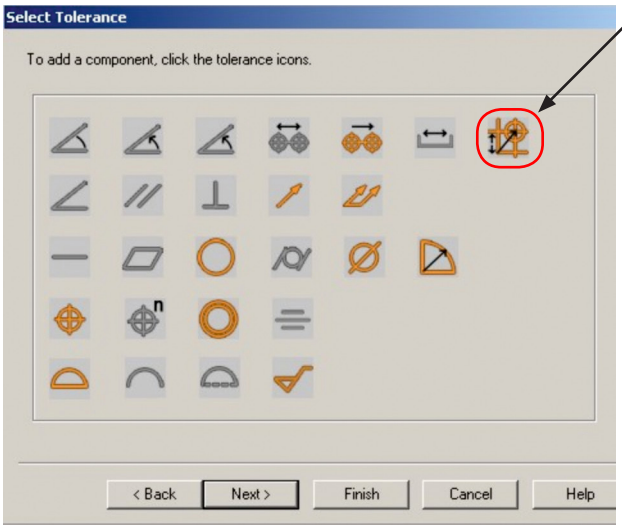
Right mouse click on the features and select ‘Output’.



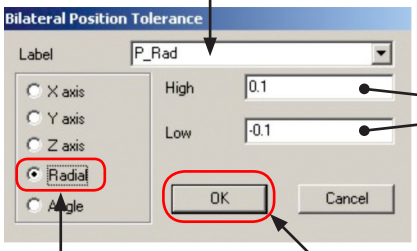
Selected features are placed in this window:

Click: ‘New’ to continue.

Click: ‘Bilateral position’.



Give the new tolerance a label to make following the program easier.

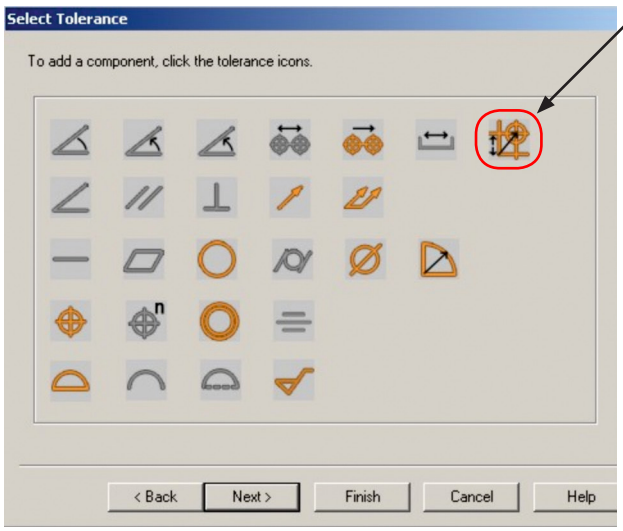


Enter required tolerances.

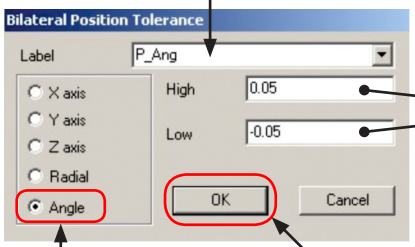
Select: 'Radial'.

Click: 'OK' to continue.

Click: 'Bilateral position'.



Give the new tolerance a label to make following the program easier.



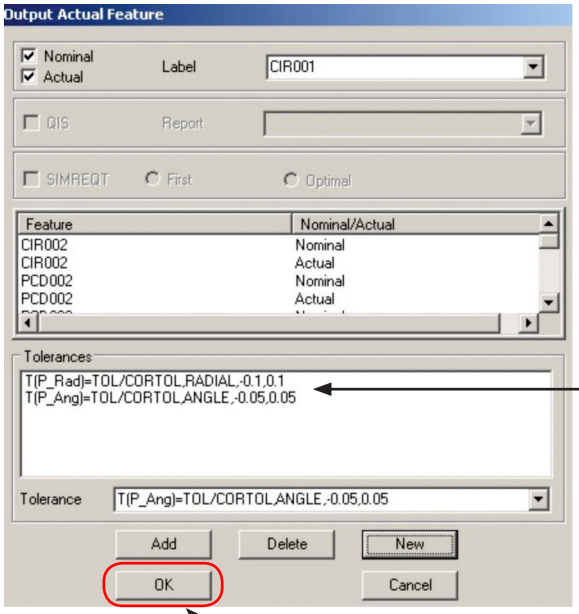
Enter required tolerances.

Select: 'Angle'.

Click: 'OK' and then 'Finish' to complete..

At this point MODUS writes the following code to the program:

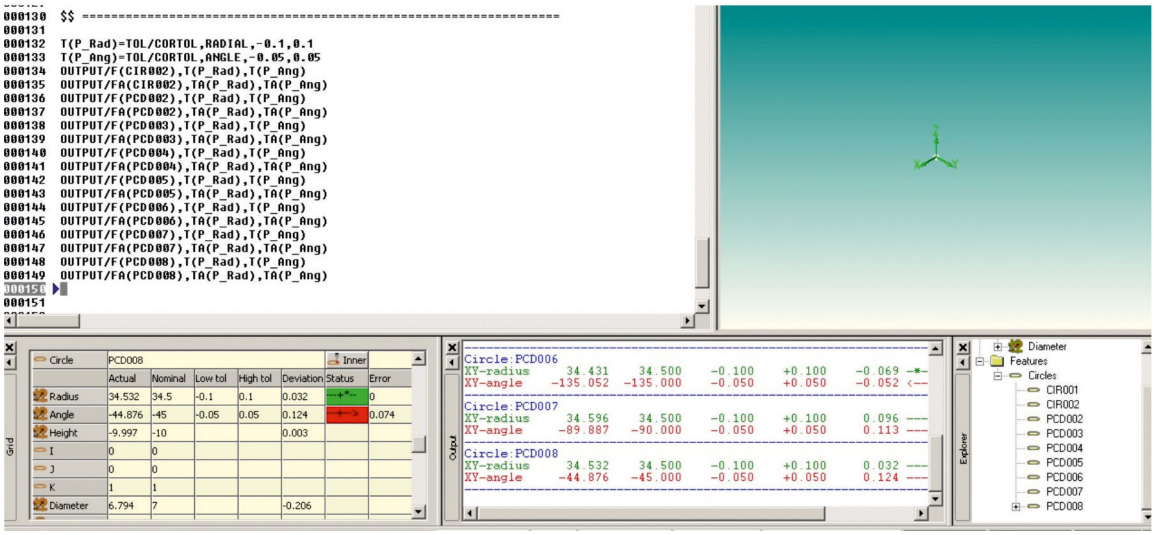
T(P_Ang)=TOL/CORTOL,ANGLE,-0.05,0.05



MODUS adds new tolerances to the 'Tolerance' window.

Click: 'OK' to complete tolerance definition

Now MODUS writes ALL the previously selected features along with the associated tolerances to the program and also populates the output window with the results:



Below is an example of the automated report generated in MODUS.

REPORT IN RTF FORMAT

```
-------------------------------------------------------------------------------
05-Jan-2011 14:14                Start Template                          Page  1
-------------------------------------------------------------------------------
(mm)           ACTUAL    NOMINAL     LO-TOL     HI-TOL DEVIATION GRAPHIC        ERROR
-------------------------------------------------------------------------------

Datum Diameter
Circle:CIR001
Diameter       79.996     80.000     -0.025     +0.025     -0.004 ---*---
-------------------------------------------------------------------------------

8 Holes Equispaced on 69.0 PCD
Circle:CIR002
XY-radius      34.551     34.500     -0.100     +0.100      0.051 ---+-*-
XY-angle        0.000      0.000     -0.500     +0.500      0.000 ---*---
-------------------------------------------------------------------------------
Circle:PCD002
XY-radius      34.520     34.500     -0.100     +0.100      0.020 ---+*--
XY-angle       45.006     45.000     -0.500     +0.500      0.006 ---*---
-------------------------------------------------------------------------------
Circle:PCD003
XY-radius      34.507     34.500     -0.100     +0.100      0.007 ---*---
XY-angle       89.896     90.000     -0.500     +0.500     -0.104 --*+---
-------------------------------------------------------------------------------
Circle:PCD004
XY-radius      34.364     34.500     -0.100     +0.100     -0.136 <--+---       -0.036
XY-angle      135.079    135.000     -0.500     +0.500      0.079 ---*---
-------------------------------------------------------------------------------
Circle:PCD005
XY-radius      34.558     34.500     -0.100     +0.100      0.058 ---+-*-
XY-angle     -180.105   -180.000     -0.500     +0.500     -0.105 --*+---
-------------------------------------------------------------------------------
Circle:PCD006
XY-radius      34.439     34.500     -0.100     +0.100     -0.061 -*-+---
XY-angle     -135.084   -135.000     -0.500     +0.500     -0.084 --*+---
-------------------------------------------------------------------------------
Circle:PCD007
XY-radius      34.448     34.500     -0.100     +0.100     -0.052 -*-+---
XY-angle      -89.890    -90.000     -0.500     +0.500      0.110 ---+*--
-------------------------------------------------------------------------------
Circle:PCD008
XY-radius      34.527     34.500     -0.100     +0.100      0.027 ---+*--
XY-angle      -45.052    -45.000     -0.500     +0.500     -0.052 ---*---
-------------------------------------------------------------------------------

PCD of 8 Holes Relative To Datum Diameter
Circle:PCD_69
X-axis          0.041      0.000     -0.050     +0.050      0.041 ---+-*-
Y-axis          0.001      0.000     -0.050     +0.050      0.001 ---*---
Diameter       68.979     69.000     -0.025     +0.025     -0.021 *--+---
-------------------------------------------------------------------------------
Duration 10 secs               FAIL in:19 out:1                  End of Report
===============================================================================
```

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